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IANDIORIO & TESKA  
INTELLECTUAL PROPERTY LAW ATTORNEYS  
260 BEAR HILL ROAD  
WALTHAM, MA 02451-1018

EXAMINER

WEISKOPF, MARIE

ART UNIT	PAPER NUMBER
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3661

DATE MAILED: 07/07/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b>		<b>Applicant(s)</b>	
	10/621,097		BRADY ET AL.	
	<b>Examiner</b>		<b>Art Unit</b>	
	Marie A. Weiskopf		3661	

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 07 April 2006.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-108 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 76,77,93,94 and 96-108 is/are allowed.
- 6) ☒ Claim(s) 1-49,51-52,64-72,78-90,92,and 95 is/are rejected.
- 7) ☒ Claim(s) 50,53-63,73-75 and 91 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)             | 4) <input type="checkbox"/> Interview Summary (PTO-413)                     |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)    | Paper No(s)/Mail Date. _____  |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____   | 6) <input type="checkbox"/> Other: _____                                    |

## **DETAILED ACTION**

### ***Claim Rejections - 35 USC § 103***

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1, 64-66, 70-72, 78, 80-83 and 92 are rejected under 35 U.S.C. 103(a) as being unpatentable over Didinsky et al in view of Rodden et al.

- In regard to claims 1, 66, and 72, Didinsky et al discloses an integrated inertial attitude sensor for an aerospace vehicle (Abstract) comprising:
  - A star camera system (Column 3, line 39)
  - A gyroscope system (Column 3, lines 54-58; Column 4, lines 23-25)
  - A flight computer responsive to the stream of data for determining from the star camera system output and the gyroscope system output the attitude of the aerospace vehicle (Column 3, lines 64-66)

Didinsky et al, however, fails to disclose a controller system for synchronously integrating an output of the star camera system and an output of the gyroscope system into a stream of data. Rodden et al, however, discloses a controller system for synchronously integrating an output of the star camera system and an output of the gyroscope system in a stream of data before inputting them to the flight computer to determine that attitude. (Figure 2; Column 3, lines 7-39) It would have been obvious to one having ordinary skill in the art at the time of the invention to

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modify the invention of Didinsky et al with the synchronously integrating as taught by Rodden et al in order to provide a system that quickly is able to determine that attitude of a system as necessary and also is able to determine if either non-inertial or only inertial data is available. (Column 6, lines 15-27)

- In regard to claim 64, Didinsky et al discloses the output of the star camera system is a star camera attitude. (Column 3, lines 54-58)
- In regard to claim 65, Didinsky et al discloses the output of gyroscope system is a gyroscope attitude. (Column 3, lines 54-58)
- In regard to claims 70 and 71, Didinsky et al and Rodden et al discloses all of the above is mentioned and also includes a single housing disposed about the star camera system, the gyroscope system, the controller system and the flight computer. This can be seen in Figure 1. The Satellite is held together by a single housing which includes each of these elements.
- In regard to claim 78, Didinsky et al and Rodden et al discloses all of the above is mentioned and Rodden et al discloses also integrating an output of the star camera system and an output of the gyroscope system in a predetermined pattern into a stream of data, the controller system including a command circuit for isolating from each other each of the star camera system output and the gyroscope system output during their integrating. (Column 4, lines 9-21)
- In regard to claim 80, Didinsky et al and Rodden et al discloses, as discussed above, a star camera system, a gyroscope system, a controller system and a flight computer. Didinsky et al also discusses the attitude acquisition for a stellar

inertial attitude determination system being autonomous. This tells that the star camera must have a self-initializing device in order to be able to self-initialize the star camera system with the attitude of the aerospace vehicle since it is autonomous and does not interact with any other outside systems. (Abstract)

- In regard to claim 81, Didinsky et al and Rodden et al discloses, as discussed above, a star camera system, a gyroscope system, a controller system and a flight computer. Didinsky et al also discusses the flight computer further comprising a self-scoring system to identify error trends in the aerospace vehicle attitude. (Column 6, lines 30-40)
- In regard to claim 82, Rodden et al discloses, as discussed above, a star camera system, a gyroscope system and a controller for synchronously integrating an output of the star camera system and an output of the gyroscope system into a stream of data adapted for input to a flight computer to determine the attitude of the aerospace vehicle. (Figure 2; Column 3, lines 7-39)
- In regard to claims 83 and 92, Didinsky et al discloses a method of inertial stellar attitude sensing for an aerospace vehicle comprising:
  - Acquiring an image of a star field output from a star camera system  
(Column 3, lines 36-53)
  - Acquiring an angular rate output from a gyroscope system (Column 3, lines 54-61)
  - Converting the data representative of the star field to a star field image to determine the star camera attitude of the vehicle (Column 5, lines 6-17)

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- Converting the data representative of the angular rate output to determine the gyroscope attitude of the vehicle (Column 5, lines 53-61)
- Resolving the star camera attitude with the gyroscope attitude to generate an attitude of the aerospace vehicle. (Column 3, lines 62-67)

Didinsky et al, however, fails to disclose selectively, synchronously integrating in a predetermined pattern the image of a star field output and the gyroscope angular rate output into a stream of data. Rodden et al, however, discloses a controller system for synchronously integrating an output of the star camera system and an output of the gyroscope system in a stream of data before inputting them to the flight computer to determine that attitude. (Figure 2; Column 3, lines 7-39) It would have been obvious to one having ordinary skill in the art at the time of the invention to modify the invention of Didinsky et al with the synchronously integrating as taught by Rodden et al in order to provide a system that quickly is able to determine that attitude of a system as necessary and also is able to determine if either non-inertial or only inertial data is available. (Column 6, lines 15-27)

1. Claims 2 and 84 are rejected under 35 U.S.C. 103(a) as being unpatentable over Didinsky et al (US 6,108,594) in view of Rodden et al (US 6,454,217) and further in view of van Bezooijen (US 5,745,869.) Didinsky et al discusses the output of the star trackers as either pixel information or horizontal and vertical information, however, fails to disclose the star tracker including an active pixel sensor (APS) for acquiring a star field image. Van Bezooijen discusses techniques for optimizing an autonomous star

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tracker and discusses using an APS for acquiring star field image which is commonly used in the art. (Column 2, line 43) It would have been obvious to one having ordinary skill in the art at the time of the invention to use an APS for acquiring a star field image in order to provide the pixel information that is obtained by Didinsky et al.

2. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over van Bezooijen (US 5,745,869) as applied to claim 2 above, and further in view of Falbel (6,098,929). Falbel discloses a three axis attitude readout system for geosynchronous spacecraft. Both Didinsky et al and van Bezooijen fail to actually disclose the star field image being converted to a digital representation of the star location and intensity by an analog-to-digital convert. Falbel discloses using the analog-to-digital convert in order to transmit the data to the spacecraft computer. (Column 3, lines 10-16) It would have been obvious to one having ordinary skill in the art at the time of the invention to include an analog-to-digital converter in order to process the data in a computer and produce the necessary attitude information.

3. Claims 4 and 85 are rejected under 35 U.S.C. 103(a) as being unpatentable over van Bezooijen (5,745,869) as applied to claims 2 and 83 above, and further in view of Johnson et al (6,577,929.) Both Didinsky et al and van Bezooijen fail to disclose the gyroscopes being used as microelectromechanical system gyroscopes. Johnson et al discloses a miniature attitude sensing suite which uses a well known microelectromechanical system (MEMS) gyroscope for the inertial sensor in the system disclosed. (Column 3, lines 10-13) It would have been obvious to one having ordinary skill in the art at the time of the invention to use the well known MEMS gyroscope in



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order to provide the inertial data so as to have accurate angular rate information provided.

4. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Johnson et al (6,577,929) as applied to claim 4 above, and further in view of Carlson (5,396,425).

The above mentioned fail to disclose the gyroscope including an analog to digital converter, which is well known, to convert the angular rate data to digital data. Carlson discloses a vertical velocity vector which teaches the fact that an analog to digital convert is needed with the gyroscope in order to provide the data to the processor to be used. (Column 3, lines 16-19) It would have been obvious to one having ordinary skill in the art at the time of the invention to include the analog to digital converter in order to receive usable information from the gyroscope.

5. Claims 6 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Johnson et al (6,577,929) as applied to claim 4 above, and further in view of Kamel (US 5,963,166.)

- In regard to claim 6, the above-mentioned fail to disclose the use of a digital data stream for the digital data that is produced. Kamel discusses the use of digital data streams for the digital data. (Column 10, line 44; Figure 5b) It would have been obvious to one having ordinary skill in the art at the time of the invention to use a data stream for the digital data in order to be able to pass the data efficiently to the processor once it has been converted.



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- In regard to claim 7, gyroscopes are created in order to provide the gyroscope system reference, rate and temperature to a system in order to be able to find the attitude.

6. Claims 8-21 and 86-87 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kamel (US 5,963,166) as applied to claim 7 above, and further in view of Tilley et al (6,285,928.)

- In regard to claims 8-11 and 86, the above-mentioned fail to disclose a three-axis gyroscope system. Tilley et al discloses the attitude data of an onboard attitude control system for a satellite being sensed by a three axis gyroscope system. It is inherent that with a three axis gyroscope system, each axis sensor would sense the angular rate along that specific axis. It would have been obvious to one having ordinary skill in the art at the time of the invention to use the three axis gyroscope system in order to provide inertial data for each axis of the aerospace vehicle so that the most precise information can be found for control.
- In regard to claims 12-14, Didinsky et al does disclose the use of application specific integrated circuits (ASIC) for the use of implementing the functions of outputting the signals. It would have been obvious to one having ordinary skill in the art at the time of the invention to continue using the ASIC as described by Didinsky et al with the three axis gyroscope in order to perform the specific function of each axis.
- In regard to claim 15, Didinsky et al discloses using hardware implementations of the functions (Column 4, lines 5-7) which would include using a field

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programmable gate array, which is also well known and commonly used in the art.

- In regard to claims 16 and 87, Rodden et al discloses also integrating an output of the star camera system and an output of the gyroscope system in a predetermined pattern into a stream of data, the controller system including a command circuit for isolating from each other each of the star camera system output and the gyroscope system output during their integrating. (Column 4, lines 9-21)
- In regard to claim 17, it's inherent that the command circuit of Didinsky et al must include a programmable logic device in order to be able to implement the integration of the outputs of the gyroscope and the star camera. Without a programmable logic device, it would be impossible to integrate the data of the two.
- In regard to claims 18-21, it is inherent that there must be some sort of register within the command circuit of Didinsky in order to be able to set the rate of camera acquisition and power and also the gyroscope power and reference. Without this, each would run continuously and waste power. Also, there must be some way to control the camera and gyroscope otherwise they would produce data that is useless.

7. Claims 22-43 and 88-89 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tilley et al (6,285,928) as applied to claim 21 above, and further in view of Hsieh et al (US 6,252,578.)

- In regard to claim 22, the above-mentioned fail to disclose the outputs of the star camera system and gyroscope system being interleaved by a data stream packer into the stream of data. Hsieh et al discloses a system which also has outputs which need to be inputted into a stream of data and to do this a data packer is used. (Column 5, lines 8-17) It would have been obvious to one having ordinary skill in the art at the time of the invention to use the data packer presented by Hsieh et al in the invention because it is well known in the art to use data packers in order to pack the data into one data stream to be able to easily process the data.
- In regard to claims 23-26, it is inherent that the command circuit of Didinsky must include a way to control when the gyroscope receives data otherwise the gyroscope would constantly send data which would not be needed. Also, the command circuit would have to include a power isolation and control circuit in order to isolate the star camera power from the gyroscope power so each can be run at separate times and not waste power. Also, there would have to be a register to set when the power isolation circuit would be able to receive a signal in order to be able to transmit power to the gyroscope system or else the gyroscope system would be unable to run.
- In regard to claims 27-33, Didinsky et al discusses the attitude reference source of the spacecraft control processor being embodied in an on-board star catalog and the attitude reference source is in communication with the spacecraft attitude determination function. (Column 4, lines 31-39) Due to the fact that they are in

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communication, it is inherent in the Didinsky et al invention that there is a star camera system processor which includes a camera memory and an image processor. Also, a camera processor for generating the star positions from the star field image that is read from the camera. A camera comparator in order to be able to compare the data captured from the camera with the data that is located in the on-board star catalog. Without these components, the system would be unable to compare the data in the catalog with the data seen by the camera.

- In regard to claim 34, the invention by Didinsky et al has a spacecraft attitude determination function which outputs an estimated spacecraft attitude measurement from the star camera information. (Column 4, lines 40-64)
- In regard to claim 35, Didinsky et al discloses after the attitude is acquired for the aerospace vehicle, the star identification function performs the function of direct matching star tracker output to the on-board star catalog in the attitude reference system. (Column 5, lines 13-16) This would convert the attitude information into an initial star position.
- In regard to claims 36-39, Didinsky et al, as discussed previously, includes inertial sensors which are used in conjunction with the star trackers to acquire the attitude of the satellite. (Column 3, lines 54-57) Since the inertial sensors are used, it is inherent that there must be a gyroscope system processor in order to work the gyroscopes and also receive data from the gyroscopes. With the processor there has to be a memory since the data is taken and then later used

in conjunction with the star tracker data. The rate of the gyroscope must also be controlled by the processor or else the data received would be useless.

- In regard to claim 40, Didinsky discusses calibrating the gyroscope (Column 5, lines 54-61) which would then process the gyroscope angular rate data and generate a compensated gyroscope rate based on the calibration.
- In regard to claim 41, it is inherent that there must be a gyroscope integrator in the invention presented by Didinsky so that the calibration data can be integrated with the angular rate data otherwise there would be no reason to calibrate the gyroscope if the data would not be able to be used.
- In regard to claim 42 and 88, Didinsky et al discloses the computer further includes an attitude processor for receiving and processing the star camera attitude and the gyroscope attitude which is the attitude determination function of the processor. (Column 4, lines 40-64)
- In regard to claim 43, Didinsky et al discloses the attitude processor including an aerospace vehicle attitude propagator for propagating the attitude of the aerospace vehicle. (Column 6, lines 16-20)
- In regard to claim 44, Rodden et al discloses a method and apparatus for rate integration supplement for attitude reference with quaternion differencing. Rodden et al discusses the attitude of the aerospace vehicle in quaternion coordinates. (Column 4, lines 45-47)

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- In regard to claim 45, Didinsky et al discloses the attitude processor having an error estimator for estimating aerospace vehicle attitude error. (Column 6, lines 34-35)
- In regard to claims 46-49, Didinsky et al discloses using a Kalman Filtering function with the attitude processing function for a predictive filter. (Column 5, lines 53-61) It would have been obvious to one having ordinary skill in the art at the time of the invention to either use a square root Kalman filter or a 27 state Kalman filter depending on the specific need for the correction data in order to reduce the error received.
- In regard to claim 51, Didinsky et al discloses the flight computer which includes a command control data interface. (Column 5, lines 17-52)
- In regard to claim 52, Didinsky et al does not specifically disclose having a serial port for reformatting a signal representing the attitude of the aerospace vehicle and a signal representing the aerospace vehicle attitude sensor, however, it would be necessary to have the serial port in order to reformat the data.
- In regard to claims 89 and 90, Didinsky et al discloses applying the attitude of the aerospace vehicle to self-initialize the star camera attitude and applying the star camera attitude to self-initialize the gyroscope system attitude. (Column 6, lines 11-16)

8. Claims 67-69 are rejected under 35 U.S.C. 103(a) as being unpatentable over Didinsky et al (6,108,594) in view of Rodden et al (US 6,454,217) and further in view of van Bezooijen (US 5,745,869) and further in view of Johnson et al (6,577,929.) As

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discussed above in regard to claims 1, 2 and 4, Didinsky et al and Rodden et al discloses:

- A star camera system
- A gyroscope system
- A controller system for synchronously integrating an output of the star camera system and an output of the gyroscope system into a stream of data
- A flight computer responsive to the stream of data for determining from the star camera system output and the gyroscope system output the attitude of the aerospace vehicle

Didinsky also mentions that the star data can be pixel information but does fail to disclose that the star camera system includes an active pixel sensor star camera and a MEMS gyroscope. Van Bezooijen discloses the APS star camera system and Johnson et al discloses the use of a MEMS gyroscope. It would have been obvious to one having ordinary skill in the art at the time of the invention to use both the APS star camera system and the MEMS gyroscope because both are well known in the art and are commonly used. Didinsky et al discusses the attitude determination and control function including both the star camera and the gyroscope to find the attitude. (Column 3, lines 64-66) As discussed previously, hardware implementations of the functions can be used. In order for Didinsky et al to be able to integrate the gyroscope data and the star camera data, the outputs at first must be isolated from each other and then integrated so that the data can be unaffected by the data of the other.



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9. Claim 79 is rejected under 35 U.S.C. 103(a) as being unpatentable over Didinsky et al (6,108,594) in view of Rodden et al and further in view of Hsieh et al (US 6,252,578.) Didinsky et al and Rodden et al as discussed previously, discloses:

- A star camera system
- A gyroscope system
- A controller system
- A flight computer responsive to the stream of data from the controller

Didinsky et al fails to disclose the controller synchronously integrating an output of the star camera system and the gyroscope system into a stream of data by a data stream packer for interleaving the output of the star camera system and the output of the gyroscope system into a stream of data. Hsieh et al discloses a system which also has outputs which need to be inputted into a stream of data and to do this a data packer is used. (Column 5, lines 8-17) It would have been obvious to one having ordinary skill in the art at the time of the invention to use the data packer presented by Hsieh et al in the invention because it is well known in the art to used data packers in order to packed the data into one data stream to be able to easily process the data.

***Allowable Subject Matter***

10. Claims 50, 53-63, 73-75 and 91 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

11. Claims 76, 77, 93, 94 and 96-108 are allowed.

***Response to Arguments***

1. Applicant's arguments, see pages 28-37, filed 4/7/06, with respect to the rejection(s) of claim(s) 1, 70-72, 78 and 80-83 under 102(b) have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of newly found prior art.
2. Applicant's arguments filed 4/7/06 have been fully considered but they are not persuasive in regard to claims 2, 5-7, 15, 22, 67 and 79.
  - In regard to claims 2 and 67, Applicant states that one of ordinary skill would not be motivated to combine Didinsky et al and van Bezooijen because Didinsky et al specifically teaches that "[t]he star trackers 20, 25 may be embodied in digital cameras based on charge-coupled devices (CCDs)", as opposed to an APS star camera. Examiner respectfully disagrees. As quoted, Didinsky et al states that the star trackers *may* be embodied in CCDs, however, it would be obvious to one of ordinary skill to be able to use any type of star tracker system that is available and known in the art.
  - In regard to claims 5-7, Applicant states that the necessity to combine many diverse references to reject the applicants' claims itself is an indication of novelty and non-obviousness. Examiner respectfully disagrees with this statement. As long as the modifications would have been obvious to one having ordinary skill in the art at the time of invention, the number of references cited does not indicate in any way the novelty and non-obviousness of the invention.

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- In regard to claims 22 and 79, Applicant argues that the reference Hsieh et al does not teach interleaving of the star camera system data and gyroscope data which the Examiner agrees with, however, Hsieh et al is solving the same problem as Hsieh et al in the need to use a data packer in order to output the data into a stream of data.

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Marie A. Weiskopf whose telephone number is (571) 272-6288. The examiner can normally be reached on Monday-Thursday between 7:00 AM and 5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Thomas Black can be reached on (571) 272-6956. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

  
**THOMAS BLACK**  
**SUPERVISORY PATENT EXAMINER**